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ABSTRACT

This case study describes what performance-based instruction looks like when committed teachers implement it in the classroom. The focus is elementary mathematics. A literature review revealed five aspects of performance-based classrooms: (1) epistemology; (2) curriculum orientation; (3) assessment paradigm; (4) instructional strategies; and (5) role expectations. These aspects were considered in the study, which took place in Kentucky where a mathematics portfolio had been mandated for state assessment purposes. A series of interviews with 10 teachers was supplemented by a year-long in-depth study of 2 of these teachers who were judged to have the highest performance-based instruction implementation. Data reveal some underlying characteristics of the performance-based classroom. It is a caring classroom characterized by connectionist learning theory and a thinking and doing curriculum and diverse opportunities to learn with ongoing assessment, feedback, and adjustment. On the basis of this study, a nascent conceptual framework may be constructed around the construct of performance-based instruction. (Contains 70 references.) (SLD)

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Performance-Based Instruction: What Does it Look Like in the Elementary Mathematics Classroom?

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Paper presented at Annual Meeting of the American Educational Research Association (AERA), Seattle, 2001

Background

The notions of performance-based instruction and assessment are not new to many classroom teachers. Undoubtedly, there have always been teachers who have purposefully cultivated their students' abilities to think creatively and critically, to apply knowledge in relevant and engaging contexts, to construct products, initiate and follow-through on projects and demonstrations, to develop points of view and unique forms of self-expression. Current large-scale school reform efforts have generated greater attention to such pedagogy by emphasizing performance-based assessments.

A premise of such performance-based assessments is that they will, in turn, drive instruction. Yet, there is not a clear picture of what that instruction might be. What is entailed in performance-based instruction? What is required of the teacher? What is expected of the students? What kinds of underlying structure and culture need to be in place for students to learn successfully in such classroom environments?

While performance-based *assessment* has received a great deal of attention in educational and policy-making circles, performance-based *instruction* has not. Consequently, teachers are given a target to aim for but do not always understand how to do the shooting. As state and national standards proliferate, the "what" of education is being increasingly defined; the "how" is often left up to the practitioner. The outcomes have been defined. What is needed is an understanding of promising "inputs."

In order to give students an appropriate and adequate opportunity to learn and perform to new performance-based standards, it is an important matter of equity that we open this "black box" of process. How does a classroom culture operate when it is focused on performance? What are the indicators? Teachers need to see real examples of teachers who are implementing performance-based instruction in their classrooms consistently, not just as an "add-on" to prepare for a state test, but with belief and commitment (Shepard, 2000). The purpose of this study is to do just that -- to describe what performance-based instruction looks like when committed teachers go about making it a reality. The focus is elementary mathematics. The question addressed in this study is: What characteristics describe a performance-based elementary mathematics classroom?

Literature Review

Defining Performance

What exactly does it mean to say that a classroom is performance-based? While most of the literature focuses on performance-based and portfolio assessment rather than instruction, there are clear and fairly consistent descriptions about particular classroom practices nested within the various analyses and cases.

Wiggins (1993) summarizes the nature of performance by saying that it entails work that requires students to apply knowledge and skills in authentic contexts. He considers it essential that students are engaged at the application level of Bloom's taxonomy. Authenticity, according to Newmann (1996), has three characteristics: (1) construction of knowledge, where the student

applies higher-order thinking processes; (2) disciplined inquiry, which involves investigating something in depth, using important concepts from within a given knowledge base, and expressing conclusions and reasoning in "elaborated communication;" and (3) creation of a product or performance that has relevance or meaning beyond certifying mastery in school.

Stiggins (1997) adds to the definition by saying that evaluation of performance involves informed qualitative judgment. That is, it is not something, which can be objectively scored, as if it were simply a matter of right and wrong. Rather, the very nature of these tasks requires more complex analysis, where the evaluator must make distinctions about degrees of excellence. Such distinctions can be made on simple or more complex performances.

Moreover, Stiggins envisions performance as a continuum. The greater the complexity and authenticity, the more performance-based the work is, he argues. Performance-based work can range, on the low end, from short on-demand tasks, such as open-response questions that require a written explanation, to projects and portfolios on the high end. Student work can be described in terms of degree of performance, based on the types of performance tasks used. In his definition, demonstrating proficiency in isolated skills in an activity-oriented way (e.g., using a measuring tape to show proficiency in measuring) does not constitute a performance. While such activities target essential skills development, it is only when the use of such skills is embedded in more complex problem-solving situations that the term performance can be used, says Stiggins.

Wolf (1990) makes the point that performance-based assessment should be "an episode in learning." That is, the learner should not just be asked to follow the path of previous learning but should be engaged with a novel task that requires an extension, application, or transfer of previous learning. The assessment should contribute to learning.

Schlechty (1991, 1997) and Herman, Aschbacher, and Winters (1992) state that effective performance depends on clearly articulated standards for content and performance. These must be clarified and negotiated, they argue, in classroom settings so that students can understand and "own" them.

Aspects of Performance-Based Classrooms

The literature about performance-based assessment and instruction focuses on five aspects related to classroom practice: (1) epistemology; (2) curriculum orientation; (3) assessment paradigm; (4) instructional strategies; and (5) changing role expectations for teachers and students.

Epistemology

The beliefs about teaching and learning that underlie performance-based classrooms focus on the nature of intelligence, the learning process, and understanding about academic disciplines.

Intelligence

The view that intelligence is a unitary and fixed trait was established in this country in the late nineteenth century and early twentieth century in the midst of developing evolutionary theory and the increasing use of IQ scores to rank and sort students. Developing a performance-based approach in the classroom, however, rests on the premise that intelligence is multi-dimensional and malleable (Gardner, 1985; Resnick, 1987; Wolf, 1991). One purpose for a performance-based approach, in fact, is an equity consideration: to allow for students to express their knowledge and understandings in a manner that is most accessible to individual intellectual strengths (Darling-Hammond, 1997). Thus, instructional importance is placed on recognizing and adapting tasks to a diversity of cognitive abilities and rates of learning.

Learning Process

The prevailing pedagogy associated with traditional, textbook-driven practice in the mathematics classroom assumes a learning theory based upon whole class direct instruction, individual guided practice, and a highly structured scope-and-sequence of topic presentation. The teacher plays the active role of knowledge dispenser, and the student is placed in the passive role of knowledge recipient. Instruction emphasizes teacher lecture and demonstration (NCTM, 2000; US Dept of Education, 1997).

Teachers focusing on performance, however, have developed a pedagogy based more upon a constructivist theory of learning. This point of view, developed through the research of cognitive psychologists, suggests that learning occurs as individuals make their own connections to prior knowledge, not as a predictable response to external stimuli (Clements, 1997; Kamii, 1985; Piaget, 1986; Resnick, 1987). Teachers subscribing to this point of view often favor building meaning through active experiences, personal engagement, and social interaction. Instruction in performance-based classrooms emphasizes student discovery, investigation, invention, and discourse. (Dewey, 1963; Labinowicz, 1985; Leinhardt, 1992; Perrone, 1994).

Papert (1993) makes an interesting distinction from the constructivist model for learning. To him, the term "constructivist" suggests that, like building physical structures such as houses, learning may be built in something of a linear sequence, if we just have the right materials and draw the proper blueprint for action. He prefers the term "connectionist" because it connotes multi-directional growth, like the plant world or like hypertext connections in cybernetic environments. Recent brain research suggests that he is correct in conceptualizing learning as more of an "associative" process (Ornstein, 1991; Sylwester, 1993). In defining connectionism, Papert also includes connections made to previous experiences, interests and skills, and other people.

Understanding About the Academic Discipline

Duschl and Gitomer (1991) suggest that a performance-based orientation must be based upon an understanding that academic disciplines are not static but rather are living bodies of knowledge that are always subject to revision and reinvention. That is, performance by practitioners within the discipline as they build onto the existing knowledge base should serve as a model for student performance. In a performance-based mathematics environment, students should act in the role of mathematicians as they search for knowledge and understanding. This is a perception of classroom performance as microcosmic version of the larger world of the academic domain: knowledge is investigated, examined, documented, reviewed by others, and revised, in a continuing cycle of development.

With this perspective in mind, it follows that a performance-based orientation assumes that studying the discipline is not a matter of simply learning truths that are finalized but rather a process of questioning assumptions, reinvestigating truths in a different context or from a different perspective, making distinctions, extending ideas. It is a matter of using the disciplinary process to solve problems and conduct inquiry, not simply a matter of demonstrating procedural skills or producing correct answers

Unless a teacher perceives the discipline of mathematics as such a thinking process, a performance-based orientation is unlikely to be seen as important (Battista, 1994).

Curriculum Orientation

Performance-based classrooms revolve around curricula that have the following characteristics: a focus on developing quality standards; an emphasis on thinking and communicating; the use of longer-term projects that serve to anchor the curriculum to authentic contexts and provide opportunities for sustained work; and an allowance for student choice in the determination of task specifications.

Developing Standards

Central to performance-based instruction is establishing a clear vision of what constitutes quality. This vision generally takes the form of task guidelines and criteria for assessment. In this era of state-mandated standards-based school reform, much of this is given by the state (Arter, 1995; Herman, Aschbacher, & Winters, 1992; Lambdin & Walker, 1994; Rothman, 1995, Stiggins, 1997; Wiggins, 1992).

Yet, an important point is made in the literature about the necessity to involve students and teachers in the formulation and continual reconsideration of these standards (Jervis, 1996; LeMahieu, Gitomer, & Eresh, 1995; Stiggins, 1997). If the students or the teachers do not take ownership of developing the standards, it is unlikely that standards will act as a driving force for the learning.

Thinking and Communicating

The epistemology underlying performance-based classrooms lends itself to a "thinking curriculum." That is, the curriculum should be designed to ensure that students have ample opportunity to demonstrate higher order thinking and applied learning (Darling-Hammond et al., 1995; Wiggins, 1993; Wolf, LeMahieu, & Eresh, 1992). Resnick (1987) defines higher order thinking as non-algorithmic and complex, often yielding multiple solutions, and involving effort, judgment, uncertainty, the application of multiple criteria, self-regulation of the thinking process, and the imposition of meaning on apparent disorder.

In a performance-based classroom, there is a great deal of communicating about learning, as students share tasks and teachers confer with students. For some, the conversations about learning which take place in the midst of student work or while reflecting upon student work are themselves a primary source of learning (Gitomer, 1991; Hackett, 1993; Mullen & Newman, 1995; Vygotsky, 1978; Walters, 1991; Wolf, 1989).

Authentic Projects

Complex thinking and ongoing communication are promoted if the curriculum includes periodic projects that require sustained effort on the part of the students (Bensman, 1995; Gitomer, 1991). Moreover, these projects, in order to provide greatest opportunity for students, should be authentic and engaging (Wiggins, 1993, 1998; Newmann, 1996). Khattri, Kane, and Reeve (1995) find that students working on projects are more motivated to learn.

Authentic projects lend themselves to having authentic audiences. There is a strong train of thought in the literature that suggests the necessity of an authentic audience, if students are going to be motivated to do the work required (Bensman, 1995; Darling-Hammond et al., 1995; Jervis, 1996; Nathan, 1995, Wiggins, 1998).

Student Choice

Student choice in project definition is an important factor in the development of student engagement. Some scholars go further and argue that the curriculum itself must allow for significant negotiation with students in order to gain student ownership of learning (Beane, 1997). Others suggest a more limited role for student involvement in the topics of study (Stiggins, 1997). Interestingly, Khattri et al. (1995) find that even when teachers adopt performance assessments and portfolios, the content and sequencing of subject matter usually

remains largely unchanged. This remains constant, the researchers suggest, because existing state and district frameworks dominate the curricular choices teachers make.

Assessment Paradigm

Many teachers view assessment as a test or quiz given at the end of a unit of study, administered for the purpose of keeping a summative score to be used with report cards (Airasian, 1994, Popham, 1995). That perspective on assessment is qualitatively different from the assessment paradigm espoused by those developing performance-based classrooms.

Schwager (1996) constructs an empirical model of assessment paradigms based upon survey data regarding teachers' beliefs, attitudes, and classroom practices related to assessment. Three paradigms are defined: the teaching paradigm, which is primarily concerned with the individual student's mastery of the specified classroom curriculum; the measurement paradigm, which centers around comparative assessments and quantification; and the cognitive learning paradigm, in which assessment is used to "trace each student's progress to share with the student to further her/his own learning" (p. 28). The literature suggests that the cognitive learning paradigm is the most conducive to performance-based classrooms.

In particular, four norms can be described from the literature: assessment serves a formative function, to give feedback to students about progress; assessment is based upon curriculum-embedded tasks; assessment is based upon professional teacher judgment; and assessment is intended to improve student self-assessment.

Feedback to Students about Progress

The primary purpose of assessment in performance-based classrooms is to inform the student (and parents) about his or her progress with respect to specified standards and to improve the learning performance (Arter, 1995; Duschl & Gitomer, 1991; Paulson, Paulson, & Meyer, 1991; Stiggins, 1997; Wiggins, 1993; Wolf, 1991). Other purposes for assessment assume secondary importance, including reporting, program evaluation, and accountability. Wiggins (1998) is especially convincing about the need for assessment to be centered on improving performance, not just "auditing" it. In order to use assessment in this formative way, he stresses the importance of giving timely feedback from assessment, immediate if possible, so as to maximize learning.

Curriculum-Embedded Tasks

Contrary to external measures, assessment in performance-based classrooms assesses the classroom curriculum from the inside. That is, assessment tasks are not simply plugged in from an external source but emerge from the ongoing classwork. Performance-based assignments are not an "add-on" but rather an integrated part of existing lessons, units, and projects (Bensman, 1995; Darling-Hammond et al., 1995; Graves & Sunstein, 1992; Jervis & McDonald, 1996; Lambdin & Walker, 1994).

Professional Judgment

The evaluation of performance is, by definition, not a matter of objective scoring, but rather one of using professional judgment in interpreting samples of student work in light of scoring guides. In many performance-based classrooms, scoring is less emphasized than developing shared understandings concerning progress related to standards. Issues of scoring that are raised at the large scale level, such as inter-rater reliability, are not that significant within the classroom (LeMahieu, Gitomer, & Eresh, 1995).

Student Self-Assessment

Throughout the literature, self-assessment is cited as an integral part of promoting student performance (Arter, 1995; Gitomer, 1991; Stiggins, 1997; Wiggins, 1993; Wolf, 1989). The central notion is that, by internalizing performance standards and reviewing his or her own work, a student can use specified criteria to see whether the work has improved. Self-assessment also fosters greater student ownership for the work (Darling-Hammond et al, 1995; Gitomer, 1991; Stiggins, 1997; Wiggins, 1998; Wolf, 1990).

Instructional Strategies

Four instructional strategies stand out as common features of a performance-based classroom: the use of student work samples to help students understand performance standards; conferencing, both student-to-student and teacher-to-student; the revision or revisiting process; and the use of project or portfolio presentations, sometimes called exhibitions, to serve as a focus, audience, and point of accountability for students.

Student Work Samples

Performance standards are usually defined in terms of criteria and scoring guides, or rubrics, which express quality work in somewhat general terms. These can tend to be abstract or subject to multiple interpretations, so many teachers in performance-based classrooms use student work in order to make the meaning of the standards more concrete and understandable (Gitomer, 1991; LeMahieu, Gitomer, & Eresh, 1995, 1995; Wiggins, 1993, 1998; Wolf, 1989). Students are able to assess their own work by comparing it to work that has been referenced to performance levels.

Conferencing

Conferencing is acknowledged throughout the literature as integral to a performance-based classroom (Arter & Spandel, 1992; Darling-Hammond, Ancess, & Falk, 1995; Gearhart, Herman, Baker, & Whitaker, 1993; Gitomer, 1991; Graves & Sunstein, 1992; Jervis, 1996; Lambdin & Walker, 1994; Stiggins, 1997). Hackett (1993), in a study comparing student work products with student conversations, finds that the level of mathematics demonstrated in the conferences actually exceeds the level shown in the product itself. Conferencing is deemed important for formative assessment purposes, for the development of a sense of audience, and as a vital part of the revision process.

Revision and Revisiting

In a classroom that focuses on achieving performance standards, it is perhaps natural that revision and/or revisiting are valued. Revision, the process of improving and polishing a particular piece of work, is often apparent in portfolio development or rehearsals for exhibitions. Revisiting, the strategy of returning to a topic that was only partially understood, can be seen as teachers structure lesson sequences and make connections to prior experiences or as students refine pieces for inclusion in a portfolio (Arter & Spandel, 1992; Duschl & Gitomer, 1991; Hackett, 1993; Lambdin & Walker, 1994; Paulson, Paulson, & Meyer, 1991; Stiggins, 1997; Wiggins, 1993, 1998).

Presentation/Exhibition

There is considerable reference to presentations and exhibitions in the literature (Bensman, 1995; Darling-Hammond, Ancess, & Falk,, 1995; Mullen & Newman, 1995; Nathan, 1995; Perrone, 1994; Stiggins, 1997; Wiggins, 1993, 1998; Wolf, LeMahieu, & Eresh, 1992). The principle involved is that students need a real audience in order to become engaged and that the audience may also serve as a focus for student accountability concerning the work. In presentations and exhibitions, students present and defend their learning and performance in

relation to the established criteria of quality. In most cases, the presentation serves as a culminating activity.

Role Expectations

Teacher-as-Leader

In performance-based classrooms, the teacher must be a leader in the sense of setting vision, facilitating the decision-making of students, and setting the conditions of work (Schlechty, 1991; Stiggins, 1997; Wiggins, 1993). In particular, the roles undertaken by the teacher-as-leader include being a model practitioner of the discipline, a mentor for students, a designer of quality work, and a manager of workshop activities.

Practitioner of the Discipline

Gitomer (1991) raises an important point about the role of teachers in the performance-based classroom. He says that the studio-like atmosphere in such a room requires the teacher to be proficient enough in the discipline to model not only the processes and approach but also to provide on-the-spot feedback and consulting to students as they work on projects. Unless a teacher has a strong enough content knowledge, he or she will not be capable of giving such immediate guidance and conducting what he calls "rolling interviews." The performance-based teacher must rely on professional knowledge and instincts more than a set lesson plan in order to deal productively with the inherent uncertainty of a workshop environment (McDonald, 1992).

Mentor of Students

The case studies in the literature virtually all depict close student-teacher relationships in which the teacher knows the students personally and provides individualized attention and mentoring (Bensman, 1995; Darling-Hammond, Ancess, & Falk, 1995; Jervis, 1996; Nathan, 1995). Successful student performance may, in fact, depend heavily upon the development of close student-teacher relationships (Kohl, 1994).

Designer of Quality Work

Teachers in performance-based classrooms do not simply use existing curriculum materials as they are but usually adapt these materials or generate new activities that fit their own particular students and contexts (Dewey, 1963; Schlechty, 1991; Wiggins, 1993; Wigginton, 1985). Considerable time may be spent on this role. Teachers in Vermont reported that they spend over 12 hours each month developing portfolio lessons for the classroom (Koretz, Stecher, Klein, McCaffrey, & Deibert, 1993).

Manager of Workshop Activities

In performance-based classrooms, where students are involved in workshop activities or projects, the teacher must be adept at managing the work so that each student is engaged. Such an orientation often means that there is more than one thing going on in the room instead of the teacher conducting whole class instruction from the front of the room (Bensman, 1995; Dewey, 1963; Gitomer, 1991). What is required of the teacher is the ability to manage simultaneous activities in the classroom.

Student-as-Worker

In performance-based classrooms, the student assumes the active role of worker (Schlechty, 1991, 1997; Stiggins, 1997; Wiggins, 1993, 1998). This role entails being a decision-maker, product developer, collaborator, and presenter.

Decision-Maker

The importance of student decision-making is underlined in the literature, to include helping to develop the standards, helping to define projects, choosing a method of solving a problem or conducting an investigation, selecting pieces for inclusion in a portfolio, and conducting self evaluations. It is student decision-making that imparts a sense of ownership. And it is that sense of ownership that engages the student in the sustained work involved in projects, conferencing, and the revision process. Unless that sense of ownership is cultivated, a performance-based classroom can become a great hardship for the teacher as she becomes occupied with giving directions and maintaining compliance and order (Stiggins, 1997).

Product Developer

Activities and projects often lead to products. In performance-based classrooms, the role of the student is to prepare and refine those products according to specified criteria and for a particular audience. The teacher helps students to do that by focusing attention on what constitutes a quality product (Bensman, 1995; Nathan, 1995; Schlechty, 1991; Wigginton, 1985).

Collaborator

Performance-based classrooms cultivate cooperative learning, particularly through group tasks, flexible seating arrangements, and conferencing. This social aspect often means that the interpersonal skills of working together may themselves need to be taught and perhaps assessed (Johnson, Johnson, & Holubek, 1994). Collaboration is related to the connectionist epistemology underlying performance-based classrooms (Dewey, 1963; Vygotsky, 1978).

Presenter

In many cases, students are expected to present and defend the quality of their work to an audience. This work may include projects and exhibitions. Like collaboration, this skill may itself need to be taught and perhaps assessed (Bensman, 1995; Nathan, 1995; Stiggins, 1997).

Summary

In summary, the literature reveals five aspects of performance-based classrooms: epistemology, curriculum orientation, assessment paradigm, instructional strategies, and role expectations. For each aspect, there are multiple indicators.

Through this analysis, an overall picture of a learner-centered classroom emerges in which students are engaged and often work together on authentic activities and projects, have regular conversations about learning and quality, and reflect on their work. Teachers in such classrooms adapt various strategies in order to mediate curriculum according to student needs and relationships between teachers and students are personalized.

An increasing number of case studies have emerged in the literature that show these characteristics in practice. Graves & Sunstein (1992) provide a volume of teacher-written cases related to writing portfolio implementation. Darling-Hammond, Ancess, and Falk (1995) describe how several schools incorporate exhibitions, portfolios, and projects, some as graduation requirements. Jervis (1996) focuses on what happens to relationships and practices in three schools as they implement portfolio work. Duckworth (1996) combines teacher stories with an analysis of how a constructivist approach is critical to elicit quality learning experiences. Schifter's (1996) two volumes of teacher-written cases in mathematics show how teachers struggle with the classroom tensions involved in promoting constructivist learning. Busick & Stiggins (1997) have developed cases that illustrate issues in assessment practice and provide questions for teacher reflection and discussions. Rose (1995) portrays several exemplary teachers in very different circumstances who are able to incorporate performance elements into their instruction. Wasley (1994) highlights and analyzes the experiences of students and teachers as they develop repertoires of strategies to address the diverse needs of their students.

In the study described below, the intent is to test and expand this picture of performance in the context of two elementary classrooms and to formulate a nascent conceptual framework for classrooms devoted to performance-based instruction.

Methods

The study was conducted in Kentucky where a mathematics portfolio had been mandated for state assessment purposes and where the ungraded primary school had been implemented in the elementary schools. Both of these contextual factors called for elementary teachers to develop and teach performance assessments. Many Kentucky teachers embraced this orientation to curriculum, instruction, and assessment and developed classrooms focused on "performance."

Through a process of nomination, utilizing references from teachers, district supervisors, state department of education consultants, and university faculty, high-implementing teachers were identified in a region of the state that included urban, suburban, and rural districts. Some of these teachers became the subjects of this study. Thus, the sample for study was not chosen randomly, but rather selected deliberately in order to establish a possible model for implementation of performance-based instruction.

This was a qualitative study conducted in two parts: a series of interviews with ten teachers and a year-long in-depth case study of two high-implementing teachers. The interviews utilized a common protocol aimed at eliciting the norms and practices of the teachers as they set about fostering expectations, organizing instruction, and collecting and analyzing evidence of student performance. Many of the questions derived from the emerging literature on portfolios, cognitive research, and national standards about effective teaching.

From the interviews, a preliminary set of "sensitizing constructs" were developed to provide flexible indicators to direct the attention of the researcher, rather than a fixed frame designed to filter the data. That is, categories for focus were established for the case study. Through the fieldwork, these categories were refined, added to, and reconfigured into the conceptual framework that is the outcome of this study

The two teachers selected for the case study, dubbed Jane and Sheila, were judged to be the highest implementers of performance-based instruction. They had worked on transforming their classrooms significantly in order to provide the environment for successful student work on performance assessment tasks. One worked in an urban district; the other in a suburban district. Both were math/science specialists in their schools, working in multi-age settings. Interestingly, they were friends and colleagues, working together with a professor at the local university on an action research project involving the use of children's literature as an avenue for mathematics instruction.

Data collection and analysis for the case study occurred in an ongoing way. Triangulation was achieved through a mix of observations, interviews, and artifact reviews. Starting with the first day of school, each classroom was visited for full or half days throughout a school year. Activities and dialogues were scripted, audiotaped, or videotaped -- and transcribed. The teachers also reviewed and described their thinking about student portfolios and exhibitions, classroom videotapes, anecdotal records, photo scrapbooks of the classrooms, and other artifacts. All three of us met together on two occasions for a joint, three-hour interview.

Also interviewed were the principals of both schools, fellow teachers, students, parents, and a university professor with whom both worked.

Artifacts reviewed included portfolios, folders and journals representing about a third of the students in each class, dozens of teacher-designed performance-tasks, open response questions, rubrics, anecdotal records, parent newsletters, lesson plan books, conflict resolution folders, teacher portfolios, teacher resumes, and applications for teacher awards. Both teachers also provided an hour-long audiotape of their own teacher-student interviews about performance tasks.

Summary and Analysis of Data

The data in this study reveal the following characteristics as underlying constructs in these performance-based classrooms: a caring classroom community; a connectionist learning theory; a thinking and doing curriculum; diverse opportunities to learn; and ongoing assessment, feedback, and adjustment. This study corroborates the literature and expands upon it by incorporating the caring classroom community as an essential part of a framework for developing a classroom devoted to performance-based instruction. In the following discussion, these constructs are elaborated based on the data collected in this study.

A Caring Classroom Community

Perhaps the most significant finding in this study is how big a role a caring community played in establishing viable performance-based instruction in these two classrooms. Both teachers were passionate and informed about how important it is that students learn to care about the relationships and the work going on in the room (Noddings, 1992). It was this caring, they felt, that accounted for the student engagement so noticeable in their classrooms. Most students did indeed appear to care about what they were doing during classroom activities. Performance-based activities were not simply dictated or manipulated. They sprang from an environment of caring.

Both teachers invested significant classroom time in tending classroom relationships and cultivating student caring, responsibility, and empowerment. They made great efforts to get to know their students as individuals and to give them a sense of safety and belonging.

Jane said that this is not simply a matter of having a good heart, but also a practical matter. Because diversity in her class is getting wider and wider, she said, she cannot be the only one giving support for learning. She needs students to give each other that support, in emotional and intellectual ways. She stressed the need for a collaborative community so that students will help each other learn.

Sheila also saw that students needed a sense of community responsibility as a prerequisite for establishing the kind of individual empowerment that she believes is a *sine qua non* for performance-based learning. Since she was a strong advocate of constructivism, she placed a lot of importance on students being able to take charge of their own learning, rather than just following the dictates of the teacher.

Both teachers felt that in order for everyone to have the freedom to take charge of their own learning, all must respect the learning rights of others. In the classroom, this meant that taking individual responsibility for one's own learning was coupled with respecting the same prerogative for others. One depended on the other.

For both teachers, empowering students to be self-directed and to make responsible decisions was contingent on effective classroom management. As Sheila's principal pointed out, having and enforcing learning community expectations is essential in a workshop approach in order for the teacher to not "spend all her time babysitting and policing." Teachers who are

trying to reduce the amount of their whole class instruction must work to have students assume greater autonomy, both as individuals and as members of a community.

In both classes, community-building was related to the understanding that the kind of learning targeted in a performance-based classroom requires intellectual risk-taking on the part of the students. Problem-solving and inquiry are processes where the correct answer or even the approach are not described in advance. In order to be successful, students must be willing to try out new ideas, to communicate these ideas to authentic audiences, to make an effort. This means that the fear of failure must be reduced.

Community-building was observed in several aspects of these two classrooms. It was seen in how the teachers related to the students, how the students related to each other, and in the caring for the work that they all did together. We shall now discuss each one of these in turn.

Teacher-Student Relationships

Both teachers in this study served as role models for their students. Students experienced Jane and Sheila being respectful towards them in tone and courtesy, and in the way they treated discipline through conflict resolution techniques and one-on-one discussions about rights and responsibilities. They saw their teachers being life-long learners who were continuing their own professional education through their action research. They saw them as fellow-learners within the classroom community, as each shared her new ideas, whether it was through a journal entry or a new way to use the internet, and showed willingness, even delight, in learning from students. They also saw them learn from their own mistakes, as they modified and changed instruction, sometimes in the middle of a lesson. Students saw their teachers collaborating with other teachers and seeking ways to engage and educate parents.

Jane and Sheila got to know their students well. They both had multiage classrooms and kept their students for two years. This was an important part of the community-building since it deepened the mutual understanding between teachers, students, and families. The teachers knew what special needs each of their students might have, including small but important details like the need to sit within touching distance of the teacher, the need to be nudged from shy passivity, or the need to be acknowledged as a class leader. Through casual conversations with students, discussions with parents, student journal-writing and presentations, they learned what interested their students so that they could steer learning activities in a way to get their attention. They knew their learning profiles, not so much through school records, as through their own kid-watching and interviewing.

This deep knowledge of students translated into more effective assessment, feedback, and adjustment. To a large degree, Jane and Sheila were able to customize or individualize instruction because they knew their students well. This was reflected in student interviews, lesson accommodations, and the descriptive narrative reports that they sent to parents.

In their relationships with students, Jane and Sheila showed that they cared for them, for their ideas, and for their learning. They openly showed affection for their students. They looked after their needs for belonging, power, freedom, and fun (Glasser, 1985) by giving them spirit-building rituals, classroom management jobs, learning choices, opportunities for socializing with each other, ease of movement within the classroom, opportunities for resolving their own disagreements, and engaging tasks. They persevered with every student ("She's never given up on a kid," said Sheila's principal) and put in the kind of extra hours that showed students they were serious about their learning.

Student-student relationships

In both classrooms, students were seated at tables with other students, not at individual desks. School work was sometimes individual in nature and sometimes group work, but student-to-student conversations and interactions were a daily part of life in the community. Thus it was crucial that student relationships be positive in nature. Of course, these classrooms had their share of behavior problems, but the frequency and intensity of conflict was reduced by giving direct attention to interpersonal skill-building. In some ways, this job was made easier in these multi-age classrooms since the "seniors" showed the way for the "juniors" regarding class norms. In Sheila's class, the pooling of student supplies into community ownership helped to reduce petty arguments.

It was common in these classrooms to see teachers take a moment to establish or reestablish a consciousness of community expectations or to attend to behaviors that were impeding learning. Sometimes they would do so in whole class settings, such as when Sheila took the time to revisit the student-constructed rights and responsibilities list or recognized someone in Friendship Circle for demonstrating a positive character trait, or when Jane negotiated consequences for playground mishaps with the whole class. Sometimes they would deal with small groups or individuals in the midst of classroom activities, such as when Sheila had students conduct active listening with each other when they couldn't come to agreement about an experiment or when Jane bent over and whispered encouraging words to a volatile student before his frustration erupted in anger.

Both teachers helped students use words and techniques to be able to conduct learning-centered conversations with others. Jane insisted on students using the polite phrase "I disagree" when they were involved in proving or disproving mathematical ideas as a class. Sheila had students give two stars and a wish when they were conferencing about each other's work. They both provided guidelines for student-to-student conferences, including rubrics, guiding questions, and modeling. They continuously monitored student interactions, in a kind of "with-it-ness" as they moved from group to group around the room.

Jane, who had much greater diversity in her urban classroom than Sheila, took special care to teach students to accept each other's learning differences. Her primary method for doing this was to help students understand the nature of multiple intelligences and that everyone had something to contribute in one vein or another.

Caring for the work

Both teachers paid close attention to creating a community that had the learning work itself at the center. Both had morning routines that were enjoyable but focused on a math problem of some kind, such as calendar math or analyzing data that they collected about each other. The rooms themselves were carefully thought-out stages for learning, with learning centers, working bulletin boards and walls, and readily accessible materials.

Both teachers took special efforts to foster student ownership for learning. In Sheila's class, students helped to set the room up at the beginning of the year, co-constructed rubrics, kept Sheila's anecdotal records in their own folders. In Jane's class, students led morning problem-solving discussions from the overhead, had some discretion in how they used their class time to finish projects, and were able to contract for grades. For both teachers, student-led parent conferences were a key strategy that involved students in goal-setting and taking ownership of their work.

Sheila talked about the emotional engagement that must exist for students to care about what they are learning. The caring for ideas that she and Jane elicited through the use of children's literature, dolls, engaging problems, giving students choices about projects, and

videotaping student exhibitions was intended to connect to the interests of students and generate intrinsic motivation to learn.

Sheila enlisted people outside the classroom to serve as authentic audiences -- a TV weatherman, the local planetarium director, and an out-of-state email correspondent -- to help create a sense of caring about the work. Jane's ongoing invention of real-life applications accomplished the same purpose, utilizing child-centered tasks such as building and flying kites, rushing up the stairs to measure horsepower, fraction dances, and so on. The sense of humor and enjoyment involved in these activities was palpable.

The philosophy of teaching and learning behind these efforts to promote caring for ideas may aptly be called connected learning. Jane and Sheila are always looking to make such connections.

A Connectionist Learning Theory

One of the most apparent things that students were doing in these classrooms was making their own learning connections. Both Jane and Sheila deliberately structured activities so that students could learn as a result of their own efforts rather than as passive recipients of knowledge from the teacher. Although the knowledge to be learned was in most cases already decided by the teacher, the method of learning still allowed students to "reinvent" that knowledge on their own. Sheila and Jane had somewhat different approaches to doing this.

Based on her understanding of constructivism/connectionism, Sheila almost never told students something that she wanted them to learn. Rather, she would orchestrate learning experiences so that students would learn through their own thinking. Of course, she acknowledged that she already knew where she wanted them to go and was going to get them there through leading them. In involving students to co-create rubrics, to "act like mathematicians," and to help decide on manipulative activities, Sheila used indirect means to get students to connect to the learning she had in mind.

Sheila accomplished much of her teaching through conferring with students as they worked on activities, through the art of questioning. Much of what Sheila did fit into the model for discussions used in reading called the "instructional conversation" (Goldenberg, 1992; Tharp & Gallimore, 1989). In this model, the teacher plays the less directive but still deliberate role of questioner rather than "teller," using students' contributions and ideas to build information and guide them to greater levels of understanding. Sheila often led through subtle, leading discussions with her students rather than telling them what it was she wanted them to know.

At the same, Sheila was also open to seizing the "teachable moment," in order to connect with student interests or discovery. She would sometimes change her lesson plan for the week, depending on what the students did or said or what events were happening in the world that could provide a learning opportunity.

Jane used an approach that was somewhat more teacher-directed. Most often, learning tasks were designed by Jane in advance, rather than as a result of student-generated questions, although student choice was often permitted within the task. She decided upon the specific questions that "inquiring mathematicians want to know," as students wrote their reflections for given activities. She gave explicit directions on learning centers and on the teacher-constructed rubrics that defined the standards. Like Sheila, Jane also used questioning as her primary method of leading discussions with students, though her questions tended to be more directive than Sheila's. She was also not averse to simply telling students what they must do.

However, the tighter structure in Jane's room does not necessarily imply a lesser degree of "constructivism." If the core idea of constructivism is that teachers must connect experiences

to something that students can use in order to make sense for themselves, then it must be said that Jane took great care to do this. She was dedicated to creating tasks and lessons that appealed to student strengths, needs, interests, and prior knowledge.

Thus, one teacher engaged students in co-designing the work; the other did most of the design work herself. One teacher had a relatively loose atmosphere in the classroom; the other ran a tighter ship. Yet both concentrated on helping students to make connections. Connectivism indeed seems a more relevant term than constructivism.

The connection to student interests, as noted, may be seen as part of community-building, especially in terms of developing a caring for the work. The tasks observed in this study were very focused on child-centered contexts and activities: dolls, snakes, snails, birds, kites, rockets, sugar-cube castles, the weather, student surveys, childhood diseases, their own feet, kaleidoscopes, machines, Olympic games, toy cars, how many marshmallows can fit in your mouth. Jane and Sheila spent a great deal of time being "teacher inventors" as they adapted or created materials for lessons seeking to make the work fun and interesting for their students.

Student needs and strengths were assessed and then addressed in a way that connected instruction to assessment. One striking method used by Jane and Sheila to connect to the needs of their students in learning mathematics was the use of children's literature, which addressed the need often identified in girls and other learners to have a story associated with quantitative information (Karp, Brown, Allen, & Allen, 1998). By using stories with strong female characters who were involved in solving dilemmas, Jane and Sheila also worked to improve female self-images related to problem-solving. Both used children's literature as springboards and contexts for lessons, investigations, and open response questions.

Real-life applications were a staple of the curriculum in both classrooms. Email and the Internet provided useful tools to enable this. Kentucky Derby fraction activities, coordinate geometry tied to latitude and longitude, graphing daily temperatures and consumption of bird feed, flag- folding, the "matharena" dance -- all were used to place the learning of mathematics in real-life and enjoyable contexts.

A Thinking and Doing Curriculum

Jane said, "I don't want a captive audience, I want an active audience." Sheila said, "I just feel that it is most important that they learn how to go deep." A student said, "You get to do it yourself -- you're not just watching somebody do it." Sheila's principal said, "It's an approach that allows the classwork and discussion to be sort of the compost pile for new thinking." What was going on in these classrooms was action and thinking wrapped up together.

Jane wanted students to "think out of the box." Sheila wanted them to know that "there aren't any fences." Both teachers provided a steady diet of hands-on mathematical problem-solving tasks and investigations in order to help students to *think*.

When Jane and Sheila talked about thinking, they were often looking for students to initiate and pursue their own questions, not just answer teacher questions. Sheila believed that student learning needed to be driven by a question: "I want kids to be able to get to the point where it's the question that drives their need to learn." This is why she often turned student discoveries into conjectures.

Jane also sought to have students focus on questions: "I know they're thinking when they can come up with a question that shows me they are analyzing, beginning to synthesize what's going on. 'What if' kinds of questions." In morning warm-up, she sometimes had them come up with survey questions; she once brought a "bucket of books" from the library and just plopped

them on the floor to help students formulate a question for a certain topic being studied in science.

Both teachers frequently asked their students open-ended questions during class discussions, designed to elicit thinking. Samples from Jane: "What are we trying to find out?" "What do you want to know?" "Is that the only answer?" "How many answers are there?" "Is there another way of doing it?" "Tell me more about why you did this," "Tell me why you think that?" Sheila : "Give us an example," "What do you predict?" "What did you learn?" "How will you find out?" "Why would that be true?" "Why do you think this is happening?" Jane had the Big Four questions for math problem solving posted in the front of the room" What do you know? What puzzles you? What patterns do you see? What strategies did you use? Sheila had math portfolio conferencing questions stapled to the inside cover of students' portfolios: Why did you choose to use these tools? Can you solve this problem another way? What if...? Through their questions, these teachers were looking for more than correct answers. They were provoking students to think.

Students in these two classrooms got a lot of practice in developing and implementing solution strategies. In Jane's room, daily morning work included problem solving, plotting points in the coordinate plane, and data-oriented problems that asked for an interpretation or inference. Even conflict resolution was presented as a problem-solving situation. In Sheila's room, students showed their strategies to each other from the overhead regularly, explained estimation strategies and pattern recognition, and played games of strategy that entailed the use of basic skills. Both classes featured written open response questions on a regular basis that asked students to show solution strategies and give an explanation.

Clearly, both teachers subscribed to the notion that students learn by doing. Jane said, "I really think the kids learn by doing. Whether it be writing, reading, singing, dancing, flipping around the room, throwing marbles, that they're engaged." Their students (and they) were on the move throughout the day, conducting short-term demonstrations, experiments, or ongoing learning center activities.

Both Jane and Sheila tried to foster student self-reflective thinking. In journals, during silent writing times, or at the end of an investigation, students were asked to write open-ended thoughts about activities or were asked to respond to specific questions. Both teachers had students keep mathematics portfolios as a means for reflecting upon their progress in understanding mathematical concepts.

Diverse opportunities for learning

Diverse classrooms require diverse instructional strategies that can address students' differences. In these two classrooms, whole class instruction was normally limited to mini-lessons or situations where they were setting up an activity or facilitating class discourse about a problem or investigation they had worked on. Teacher-talk did not dominate the room. Instead, there was more of a decentralized approach to classroom learning.

As a norm, Jane and Sheila would set expectations and conditions, organize students into work groups, and move through the room guiding and assessing. Different students sometimes got different sorts of direction, or accommodations, from the teacher, depending on needs and strengths. Still, the same performance standard was held as the goal for all.

Performance standards were set in these rooms primarily through the use of rubrics and samples of student work that illustrated what might be considered good work. Many teachers see rubrics as scoring instruments but not as instructional tools (Airasian, 1994; Popham, 1995). In contrast, Jane and Sheila used them instructionally to set expectations and guide the work. Sheila

said that a rubric "allows children to have a goal and to see the steps to get there. Because that's what a rubric is -- it's like a ladder to get to a quality presentation or a quality product. If they don't have it, they just have no support." Jane explained that a rubric not only sets the expectation, but it also helps instill confidence: "Your purpose in using a rubric is to get them to invest in it. So that they're looking at that ahead of time and they're saying, 'You know, I can do that.'" In other words, both teachers saw using rubrics as a means of providing students with an opportunity to learn, not just as a method for the teacher to get a grade.

In order for rubrics to improve learning, Jane and Sheila made them available all during instruction. Some rubrics, such as the state Holistic Mathematics Scoring Guide stayed on Jane's wall all year long. Some, associated with particular projects or tasks, got tucked into their folders and portfolios. Some were written directly on the open response questions, on project and learning center directions, or on Jane's learning contracts. The teachers sometimes used just criteria instead of full rubrics. Students' attention was directed to these rubrics during whole class discussions, small group conversations, and one-on-one interviews. They often received written feedback from Jane and Sheila in the form of highlighted or annotated sections of rubrics.

Student work was gathered in various ways to illustrate standards. Both teachers would look for student work as they moved through the room to share with the whole class. Sometimes students were given transparencies and asked to come explain their work at the overhead. Written answers to open response questions that were judged to "meet the standard" were shown to students and analyzed. In this way, they illustrated or "benchmarked" the standards.

Students practiced applying the standards to their own work and exchanged their open responses for feedback or mock scoring. In Sheila's class, students had rubric in hand as they gave feedback to their fellow students on exhibitions.

Among the instructional strategies that Jane and Sheila used, perhaps the most pervasive was the workshop approach. Sheila consciously structured her daily lessons in terms of mini-lessons and small group work, accompanied by student-teacher interviews, similar to a writing workshop. Jane's style of workshop was more similar in style to Japanese lessons where students are given open-ended problems to solve, then present their ideas to each other (U.S Department of Education, 1997).

The notion of scaffolding was an important one for both Jane and Sheila. The idea is that the standard is kept high for all students, but some students are given extra assistance to allow them to perform at a higher level than they might if unassisted. As time goes on, this assistive scaffolding is gradually removed so that students can perform on their own. Such an instructional strategy could be seen in a number of ways in these two classrooms.

One way was in lesson design. Jane stated that in her lesson and task design work, she was purposeful about including entry points for all students (the floor is low) while also allowing extension possibilities for those who are advanced (the ceiling is high). She did this so that all students could have some success upon which they can build regardless of their current achievement level. Here are her comments: "If you give one generic thing, it's not going to fit the needs of all your kids. That's why you tweak it and mend it, so that it's open-ended enough that you're going to learn something about what everyone knows, but it's not so open-ended that you have no idea about whether they know the specific thing you're trying to teach. Sheila agreed: "I like to be able to give assignments that have alternate journeys and alternate destinations."

Jane used her understanding of multiple intelligences to provide access to students who might be strong in visual, kinesthetic, or interpersonal intelligences, but couldn't read or write

very well. Many of the direction sheets that she used had illustrations. It was, she believed, a strategy for helping some students gain access to the problem. Many times, she would give a handout, show it on the overhead, and talk about it, as she tried to give everyone a starting point.

Sheila's workshop approach freed her up to work one-on-one with some students who needed special assistance. She was also able to diagnose problems that she might not even notice if she had only been doing whole class instruction.

A scaffolding strategy was evident in Jane's room in the way she introduced problem-solving strategies. In the beginning of the year, she guided students in using specific strategies, such as drawing a picture or finding a pattern. As the year progressed, she no longer guided them so directly but rather reminded them of the various strategies they had worked on and asked them to make their own decisions about what to do for the given problem. The movement was from the teacher giving directions towards greater student decision-making. In a similar way, her morning warm-ups moved from simple tasks early in the year to more complex tasks later on that required multiple steps or higher level thinking.

Another scaffolding strategy Jane used related to problem-solving was to provide conversation about a given problem before turning students loose to solve it. Commenting on this, she said, "I like to use a set of questions as we look at new problems to solve. What do you know? What questions do you have? This is so those children, particularly females who need to communicate before they get started, have a chance to listen to the kinds of thinking going on around the room before we actually work on it." Sheila replied, "It's like we're rehearsing solving the problem."

In both classrooms, there was signage on the walls that served as scaffolding. For example, Jane had a multiplication chart to help those who needed help with facts, "Explain a Graph" prompts suggesting what questions a student might answer in order to interpret a graph, and definitions of verbs used in commonly used in open response questions.

The multi-age configuration in these two classrooms created a built-in need for such scaffolding strategies, by creating an even more diverse classroom than might otherwise be the case. In part, the configuration also supplied the conditions to address this need. The possibilities for flexible grouping of students with a greater range of skills and experiences allowed Jane and Sheila a greater ability to place students, either in heterogeneous groups where they could learn from other students or in more homogeneous groups where they could work on customized tasks or receive special teacher attention.

Jane and Sheila relied upon student conferences for a variety of purposes, one of which was to give students another opportunity to learn. In scheduled one-on-one interviews, and in "rolling conferences", they were able to diagnose what a student needed and provide immediate feedback to help that student learn. These conferences often happened during learning center time or as students were working in small groups during extended projects or investigations.

Projects gave students an opportunity to make choices and to demonstrate their learning in different modes. Particularly in Sheila's room, students had the chance to pursue interests of their own choosing and to present it in their own ways. Jane approached projects in a way that gave more guidance to student choices. She saw this as partly a matter of scaffolding, explaining: "I think we have to model what we mean by making choices, maybe by using our students and putting them in role-playing situations, by presenting visuals in the classroom, developing a strategy list, rules for conflict resolution, and so on. They can't just pull that from their memory banks. You have to do some teaching to that art."

Learning centers provided an organizational way to manage workshop activities and provide a means for differentiating instruction. By providing a variety of high-level and lower-level activities in each center, and combining this with student choice, Jane provided yet another way of customizing instruction. In both rooms, practice-oriented games that have been used in a whole class setting were then located in learning centers for students to use.

Both teachers made tools as accessible as possible to students. Students were free to get manipulatives from the clear plastic tubs any time they thought they needed to use them. Jane and Sheila used manipulatives primarily to develop understanding of abstract concepts through concrete experiences. On several observed occasions, Sheila prompted students to use several types of manipulative with the same problem in order to show multiple representations for given concepts.

Calculators were also available to students whenever they needed them. Both teachers expressed the belief that calculators not only serve to extend problem solving possibilities but also provide access to higher level thinking for many students who are not strong on computational skills.

Multiple learning opportunities were provided to students through revisiting lessons and revising work. Jane repeated a lesson about volume later in the year when she felt students had learned enough about using sampling as an estimation skill to be more successful than they had been when she first taught the lesson. Sheila provided time for students to rehearse their exhibitions or to review math portfolio pieces before parent conferences. Jane intentionally presented math concepts in type of spiral math curriculum through the year, building in multiple opportunities with particular math concepts in an ongoing way.

In both classes, teachers provided authentic audiences as a means of giving students a real purpose to demonstrate their learning. This was done through videotaped exhibitions, where the students were their own audience; by inviting parents to be part of special events or to be correspondents through email or letter exchanges; by reaching into the community, as Sheila did by getting the weather man to come to her classroom; by coordinating interactions between classes; by student-led conferences; by passing the portfolios on to the next year's teacher. Jane and Sheila both regarded authentic audiences to be critical elements of developing a performance-based classroom.

Ongoing assessment, feedback, and adjustment

Jane and Sheila paid close attention to classroom assessment because they saw it as a means for improving learning. They sought to help their students achieve standards by understanding who they were and where they were in relation to standards, then working from where they were to where they needed to go. Improvement in the light of standards was the goal.

At the beginning of the year, in order to lay the foundation for responsive assessment practices, both made special efforts to get to know their students. Jane made a "sweep" of phone calls and conducted what she called "intake" conferences with parents. She deliberately had casual conversations with every student, while walking down the hallway or during "down time." She created learning situations where she could watch them in action and get them to talk, using her kidwatching skills to gain valuable information about who these students were. Likewise, from the very first day, Sheila conducted a daily Friendship Circle where students could share their lives. This kept her in close touch with her students and their lives. Both teachers considered it critical that they had their students for two years, largely because it enabled them to develop personalized relationships.

In addition, both teachers were very well informed about current content and performance standards in mathematics. Through professional development and leadership experiences, they had kept abreast of the curriculum developments in the state, had been integral parts of school curriculum alignment efforts, and knew how to write their own curriculum-embedded tasks for classroom use. Thus, their classroom assessments were well-grounded in professionally accepted standards.

While both teachers made use of traditional materials to test their students for matters of objective knowledge and recall, it was their performance-based assessment repertoire that provided the primary engine for their classrooms. Their assessment strategies were wide and varied. Both were systematic as they planned assessment tasks to fit with what they were teaching, kept records, gave formative feedback to students, informed parents, and adjusted their own instruction.

Rubrics served double duty in these classrooms, as both instructional and assessment tools. In the area of assessment, they provided a scale for the measurement of qualitative performances that involved judgment. As noted above, both teachers created and used a variety of rubrics, using the language of the rubrics in their grade books, feedback to students, and reporting to parents. Their rubrics guided their judgment daily in the analysis of student products and activities.

Rubrics in these classrooms were used in conjunction with exhibitions, projects, performance events, open response items, and sometimes with anecdotal records. Exhibitions, where students stood and made presentations to the class, were more prevalent as a form of assessment in Sheila's class. Sheila and her students used an exhibition rubric to give feedback to the student presenters. Jane also used a rubric to evaluate student exhibitions, though she says that most of her assessment information came in the observation of the activities leading up to the exhibition (for which she has a rubric).

Open response items were scored with rubrics by students as well as by the teachers. In this way, self-assessment became part of the process. Writing done in connection with projects or performance events was also evaluated with a rubric.

Both Jane and Sheila looked at their assessment information, including scores derived from rubrics, with a main focus on providing feedback to students for improvement and on improving their own instruction. Usually students received not just their score back but also information about why that score was given in the form of written notes from the teacher. They also received the whole rubric with highlighted sections so that they could tell what descriptors applied to their work. Jane and Sheila talked to students in follow-up interviews as necessary to help elaborate on this feedback.

Other forms of assessment did not necessarily receive a score. Observations and interviews, perhaps the most important assessment strategies in these rooms, were documented as anecdotal notes. Jane would sometimes add rubric scores to her notes as additional information. The portfolios in these classrooms were not scored at all. The main use for portfolios was to show improvement over time, especially viable in a class where students spent two years. The journals were also not scored. They were used for diagnosis and possible instructional adjustment.

A Conceptual Framework for Performance-Based Instruction

On the basis of this study, a nascent conceptual framework may be constructed around the construct of performance-based instruction. In particular, elementary performance-based mathematics classrooms may be said to show the following instructional characteristics:

- A caring classroom community

Teachers deliberately build a classroom environment based on caring, student empowerment, and mutual responsibilities. Students make decisions, work together, respond to each other's work, and resolve conflicts in a climate characterized by respectful relationships and a focus on learning.

- A connectionist learning theory

Teachers believe and act on the principles that students make their own connections; that instruction must be connected to the needs, strengths, and interests of students; that understanding must be developed through making linkages to prior and related learning experiences and real-life applications; and that social interaction is an essential ingredient for individual learning.

- A thinking and doing curriculum

Teachers emphasize student thinking through the use of tasks that actively engage students in hands-on experiences that entail problem solving and exploration. Students are expected to pose questions, develop and implement solution strategies, conduct and share investigations and research, demonstrate understanding of concepts, explain thinking, make presentations, and reflect upon their own learning.

- Diverse opportunities for learning

Teachers provide diverse learning opportunities through a variety of instructional strategies. They make standards visible through descriptive rubrics and illustrative models. They structure learning experiences to respond to student differences through techniques such as workshop approaches, scaffolded lesson design and delivery, flexible grouping, conferencing, projects, learning centers, accessibility to tools, multiple learning opportunities, and authentic audiences.

- Ongoing assessment, feedback, and adjustment

Teachers ground their judgments in personalized knowledge about their students and in content and performance standards. They use a varied assessment repertoire in a systematic way both to provide students with guidance for improvement and to inform and modify instruction. Strategies include developing and using rubrics to evaluate student products, exhibitions, projects, and open-response writing; documenting observations and interviews; analyzing portfolios and journals; and promoting student self-assessment.

It is an interesting exercise to try to draw a schematic of how these five components interact with each other. One might think of intersecting circles because none of these categories are mutually exclusive. For example, adjusting instruction on the basis of assessment feedback is also making connections to students' needs and strengths. Having students work together is a means of fostering community, but it is also a way of tapping into the "zone of proximal development" that promotes cognitive growth (Vygotsky, 1978). A rubric provides an opportunity to learn, but it is also an assessment instrument.

If one attempts to conceptualize one component at the center of a wheel around which the others revolve, a likely candidate for the hub is connectionist learning theory since it appears to be the most inclusive. In our current era of assessment-driven reform, many might argue that

assessment should be at the center of the wheel, "driving" the others. The teachers in this study, however, argue heartily that community lies at the center of the wheel.

Conclusion

This study is a beginning attempt to formulate what instructional aspects of an elementary classroom may contribute to student success in performance-based assessments. In each classroom, the teacher had ample documentation to demonstrate the extent of improvement in each student's understanding according to given performance standards. Left unstudied is whether these classroom level assessments may be correlated to larger scale, external assessments. In the current climate of large scale assessment, a study devoted to making that correlation may be of great value. It may also be of value to evaluate the degree of validity, reliability, and fairness involved in classroom level assessment simply on its own terms, without respect to large scale external assessments. Indeed, some reform-minded educators recommend that well-designed and administered local and classroom assessments may be the key to establishing a system of school accountability that does not entail state-wide standardization (CARE, 2000; Stiggins, 1997; Whitford & Jones, 2000).

The value of this study lies in its descriptive power. Here is a picture of what performance-based instruction can look like when teachers are committed to it, with a fine-grained detail that may allow teachers to think through the "inputs" necessary for nurturing student performance. Here is a case study that may be a resource for teachers as they conduct their own professional development focused on teaching to NCTM's *Principles and Standards for School Mathematics* (NCTM, 2000). And it may be that here is a conceptual framework that can provide a structure for analyzing a performance-based professional practice.

The limitations of this qualitative study are clear enough, based on a small number of interviews and two classrooms. Further studies that focus on the same question with other grade levels and other subject areas would certainly add to the understanding of what a performance-based classroom looks like. Here's hoping there's more to come.

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